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# INVESTIGATIONS OF HEMORRHAGIC FEVER WITH RENAL SYNDROME (HFRS) IN YUGOSLAVIA

MIDTERM REPORT

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19 ABSTRACT (Continue on reverse if necessary and identify by block number)

Five hundred and forty four rodents and small mammals were trapped in various regions of Yugoslavia and examined. Antihantaviruses, immunofluorescent (IF) antibodies were detected in the blood samples of 129 animals. Antigens were detected in the lung samples of 139 animals. Sixty-seven animals tested positive for both the presence of antibodies in the sera and antigens in the lungs. Studies on the immune status of healthy people in various HFRS endemic areas were conducted. Blood samples from over 700 forest workers, farmers, and other individuals with considerable outdoor exposure were collected and tested serologically for antibodies to hantaviruses. Approximately 336 individuals possessed hantaviral antibodies. In 1989, an HFRS epidemic occurred throughout Yugoslavia, over 600 individuals were hospitalized and 15 deaths occurred. The epidemic occurred in all six republics and two provinces of Yugoslavia, in both previously recognized and newly recognized foci areas. The greatest number of HFRS patients were from the Republics of Bosnia, Herzegovina, and Serbia. In the beginning of the epidemic, it was determined that

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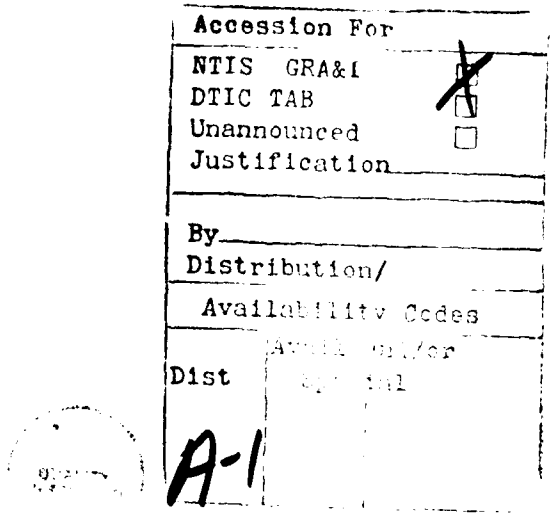
19. Abstract (continued)

the most severe cases of HFRS, and ultimately the highest lethality rate, occurred in those individuals with a specific immune response against Hantaan rather than Puumala. More detailed data are currently being gathered and analyzed.



FOREWORD

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__✓__In conducting research using animals, the investigator(s) adhered to the "Guide for the Care and Use of Laboratory Animals," prepared by the Committee on Care and Use of Laboratory Animals of the Institute of Laboratory Resources, National Research Council (NIH Publication No. 86-23, Revised 1985).

_____For the protection of human subjects, the investigator(s) adhered to policies of applicable Federal Law 45 CFR 46.

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Ana Glisić, May 7, 1990

PI Signature Date

Table 1.

Small mammals captured in endemic areas in Yugoslavia tested for IF antibodies to Hantaan and Puumala viruses and hantaviruses antigens

| Location | Species | Number of Trapped | Number of Ang.Positive | Number of Ant.Positive | Number of Ang. &Ant.Positive |
|---|---|---|---|---|---|
| Čačak | Apodemus flavicollis | 1 | 1/1 | 0/1 | 0 |
| | A.sylvaticus | 90 | 14/90 | 4/90 | 3 |
| | A.agrarius | 44 | 6/44 | 2/44 | 2 |
| | A.microps | 5 | 1/5 | 1/5 | 1 |
| | Sorex araneus | 1 | 0/0 | 0/1 | 0 |
| | Crocidura subalveolens | 8 | 2/8 | 0/2 | 0 |
| Ivanjica | A.flavicollis | 12 | 3/12 | 2/12 | 1 |
| | A.sylvaticus | 17 | 4/17 | 0/17 | 0 |
| | Clethrionomys glareolus | 1 | 1/1 | 1/1 | 1 |
| | Pitimys subterraneus | 1 | 1/1 | 0/1 | 0 |
| | Mus musculus | 7 | 3/7 | 0/7 | 0 |
| | Sorex araneus | 2 | 1/2 | 0/0 | 0 |
| | Neomys fodiens | 2 | 2/2 | 0/0 | 0 |
| Požarevac | A.flavicollis | 11 | 1/11 | 1/11 | 1 |
| | A.sylvaticus | 24 | 5/24 | 2/24 | 1 |
| | A.agrarius | 20 | 4/20 | 2/20 | 2 |
| | A.microps | 1 | 0/1 | 0/0 | 0 |
| | P.subterraneus | 2 | 0/2 | 0/0 | 0 |
| | M.arvalis | 2 | 0/1 | 0/1 | 0 |
| | Mus musculus | 21 | 8/20 | 6/18 | 4 |
| | Rattus norvegicus | 5 | 5/5 | 4/5 | 4 |
| | Crocidura subalveolens | 5 | 1/5 | 0/0 | 0 |
| Karlovac and Oštarije | A.flavicollis | 1 | 1/1 | 0/1 | 0 |
| | A.sylvaticus | 1 | 1/1 | 0/1 | 0 |
| | R.Norvegicus | 16 | 4/16 | 7/16 | 2 |
| Novo Mesto | A.flavicollis | 3 | 2/3 | 0/3 | 0 |
| | A.sylvaticus | 6 | 1/6 | 0/6 | 0 |
| | P.subterraneus | 1 | 0/1 | 0/1 | 0 |
| Plitvice Lakes | A.flavicollis | 84 | 17/84 | 27/83 | 9 |
| | Cl.glareolus | 60 | 18/60 | 30/58 | 14 |
| | Sorex alpinus | 1 | 1/1 | 0/1 | 0 |
| Olovo | A.flavicollis | 28 | 7/28 | 12/25 | 5 |
| | A.sylvaticus | 6 | 1/6 | 3/6 | 1 |
| | Mus musculus | 1 | 1/1 | 1/1 | 1 |
| Hadžići | A.flavicollis | 49 | 21/49 | 24/49 | 15 |
| | A.sylvaticus | 2 | 0/2 | 0/2 | 0 |
| | Cl.glareolus | 2 | 1/2 | 0/2 | 0 |
| | M.species | 1 | 0/1 | 0/1 | 0 |
| T O T A L | | 544 | 139/541 | 129/516 | 67 |

No.positive/No.examined

IF = imunofluorescent test; NT = not tested; Ang. = antigen; Ant. = antibody

Table 2.
Percentage of hantavirus antigen (IFA) in different species of small mammals according to different endemic foci of HFRS in Yugoslavia during epidemic in 1989

| Endemic Foci | CACAK | | IVANJICA | | POZAREVAC | | KARLOVAC | | N. MESTO | | PLITVICE | | OLOVO | | HADICI | | TOTAL | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | %1 | Ag+2 | %1 | Ag+2 | %1 | Ag+2 | %1 | Ag+2 | % 1 | Ag+2 | %1 | Ag+2 | %1 | Ag+2 | %1 | Ag+ 2 | %1 | Ag+2 |
| Small Mammals | | | | | | | | | | | | | | | | | | |
| APODEMUS AGRARIUS | 29.5 | 15.9 | - | - | 22.2 | 20.0 | - | - | - | - | - | - | - | - | - | - | 11.8 | 17.2 |
| A.FLAVICOLLIS | 0.7 | 100.0 | 28.6 | 25.0 | 12.2 | 9.1 | 5.5 | 100.0 | 30.0 | 66.7 | 57.9 | 20.2 | 80.0 | 20.0 | 90.7 | 44.9 | 34.8 | 28.6 |
| A.MICROPS | 3.4 | 20.0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.9 | 20.0 |
| A.SYLVATICUS | 60.4 | 15.5 | 40.5 | 23.5 | 26.6 | 20.8 | 5.5 | 100.0 | 60.0 | 16.7 | - | - | 17.1 | 16.7 | 3.7 | - | 26.9 | 17.8 |
| CLETHRIONOMYS GLAREOLUS | - | - | 2.4 | 100.0 | - | - | - | - | - | - | 41.4 | 30.0 | - | - | 3.7 | 50.0 | 11.6 | 31.7 |
| MICROTUS ARVALIS | - | - | - | - | 2.2 | - | - | - | - | - | - | - | - | - | - | - | 0.4 | - |
| MICROTUS SPECIES | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1.8 | - | 0.2 | - |
| PITIMYS SUB. | - | - | 2.4 | 100.0 | 2.2 | - | - | - | 10.0 | - | - | - | - | - | - | - | 0 7 | 25.0 |
| MUS MUSCULUS | - | - | 16.6 | 42.8 | 23.3 | 40.0 | - | - | - | - | - | - | 2.8 | 100.0 | - | - | 5.3 | 32.1 |
| RATTUS NORVEGICUS | - | - | - | - | 5.5 | 100.0 | 88.9 | 25.0 | - | - | - | - | - | - | - | - | 3.9 | 42.8 |
| CROCIDURA SUB | 5.4 | 25.0 | - | - | 5.5 | 20.0 | - | - | - | - | - | - | - | - | - | - | 2.4 | 23.1 |
| SOREX ALPINUS | - | - | - | - | - | - | - | - | - | - | 0.7 | 100.0 | - | - | - | - | 0.2 | 100.0 |
| SOREX ARANEUS | 0.7 | - | 4.8 | 50.0 | - | - | - | - | - | - | - | - | - | - | - | - | 0.6 | 50.0 |
| NEOMIS FODIENS | - | - | 4.8 | 100.0 | - | - | - | - | - | - | - | - | - | - | - | - | 0.4 | 100.0 |
| TOTAL No. | 149 | 24 | 42 | 15 | 90 | 24 | 18 | 6 | 10 | 3 | 145 | 36 | 35 | 9 | 54 | 23 | 543 | 140 |
| % | 100.0 | 16.1 | | 35.7 | | 26.6 | | 33.3 | | 30.0 | | 24.8 | | 25.7 | | 42.3 | | 25.8 |

Ag = hantavirus antigen
"1" = % from the number of trapped small mammals
"2" = % Ag positive from total number of investigated species

TABLE 3
Presence of hantavirus antigen and antibody in different species of small mammals according to age and sex during epidemic of HFRS in Yugoslavia in 1989

| Mammals | Ag | Ab | Ag and Ab | Juvenile form | Subadult form | Adult form | Male | Female |
|---|---|---|---|---|---|---|---|---|
| APODEMUS AGRARIUS | 11 / 64 | 6 / 64 | 6 / 64 | 3 | 36 | 25 | 31 | 33 |
| A. FLAVICOLLIS | 54 / 189 | 66 / 184 | 33 / 184 | 3 | 20 | 166 | 112 | 77 |
| A. MICROPS | 1 / 4 | 1 / 4 | 1 / 4 | 0 | 1 | 4 | 1 | 4 |
| A. SYLVATICUS | 26 / 146 | 9 / 146 | 6 / 146 | 3 | 31 | 112 | 89 | 57 |
| CL. GLAREOLUS | 20 / 63 | 31 / 61 | 15 / 61 | 0 | 3 | 60 | 18 | 45 |
| MICROTUS ARVALIS | 0 / 1 | 0 / 1 | 0 / 1 | 0 | 1 | 1 | 2 | 0 |
| MICROTUS SPECIES | 0 / 1 | 0 / 1 | 0 / 1 | 0 | 0 | 1 | 1 | 0 |
| PITIMYS SUB. | 1 / 4 | 0 / 2 | 0 / 2 | 0 | 1 | 3 | 0 | 4 |
| MUS MUSCULUS | 9 / 29 | 5 / 26 | 5 / 26 | 4 | 7 | 18 | 15 | 14 |
| RATTUS NORVEGICUS | 9 / 21 | 11 / 21 | 6 / 21 | 6 | 0 | 15 | 8 | 13 |
| CROCIDURA SUB. | 3 / 13 | 0 / 2 | 0 / 2 | 0 | 2 | 11 | 7 | 6 |
| SOREX ALPINUS | 1 / 1 | 0 / 1 | 0 / 1 | 0 | 0 | 1 | 1 | 0 |
| SOREX ARANEUS | 1 / 2 | 0 / 1 | 0 / 1 | 0 | 1 | 2 | 1 | 2 |
| NEOMIS FODIENS | 2 / 2 | 0 / 0 | 0 / 0 | 0 | 0 | 2 | 1 | 1 |
| TOTAL | 139/540 | 129/516 | 67/516 | 19 | 103 | 421 | 287 | 256 |

Ag+ = No. hantavirus antigen positive / No of investigated
Ab+ = No. hantavirus antibody positive / No of investigated

TABLE 4
Percentage of hantavirus antigen and antibody positive small mammals
according age and sex in correlation with different focci of HFRS in Yugoslavia in 1989

| FOCI | CACAK | IVANJICA | POZAREVAC | KARLOVAC | NOVO MESTO | PLITVICE | OLOVO | HADICI | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| Ag+ | 16.2 | 35.7 | 26.6 | 33.3 | 30.0 | 24.8 | 25.7 | 42.6 | 25.8 |
| Ab+ | 4.9 | 7.9 | 16.6 | 38.8 | 0.0 | 40.1 | 50.0 | 44.4 | 25.0 |
| Ag+ and Ab+ | 4.2 | 5.2 | 15.4 | 11.1 | 0.0 | 16.2 | 21.8 | 27.7 | 12.9 |
| Juvenile | 2.1 | 0.0 | 6.6 | 33.3 | 10.0 | 1.4 | 0.0 | 1.8 | 3.5 |
| Subadult | 40.9 | 4.7 | 22.2 | 0.0 | 10.0 | 13.8 | 5.7 | 1.9 | 18.9 |
| Adult | 55.7 | 95.3 | 71.2 | 66.7 | 80.0 | 84.8 | 94.3 | 96.3 | 77.6 |
| Male | 63.7 | 33.3 | 46.7 | 44.4 | 60.0 | 44.8 | 71.4 | 66.7 | 52.8 |
| Female | 36.3 | 66.7 | 53.3 | 55.6 | 40.0 | 55.2 | 28.6 | 33.3 | 47.2 |

Ag+ = No. of Antigen positive
Ab+ = No. of Antibody positive

TABLE 5
Hantavirus antigen and antibody positive small mammals in
CACAK region according to age and sex

| CAKAK | No.trapped | Ag+ | Ab+ | Ag+andAb+ | Juvenile fofm | Subadult form | Adult form | Male | Female |
|---|---|---|---|---|---|---|---|---|---|
| APODEMUS AGRARIUS | 44 | 7 | 2 | 2 | 1 | 27 | 16 | 22 | 22 |
| A.FLAVICOLLIS | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 |
| A.MICROPS | 5 | 1 | 1 | 1 | 0 | 1 | 4 | 1 | 4 |
| A.SYLVATICUS | 90 | 14 | 4 | 4 | 2 | 26 | 62 | 67 | 23 |
| CROCIDURA SPEC. | 8 | 2 | 0 | 0 | 0 | 6 | 2 | 4 | 4 |
| SOREX ARANEUS | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 |
| TOTAL No. | 149 | 24 | 7 | 7 | 3 | 60 | 86 | 96 | 53 |

Ag+ = No. of Antigen positive
Ab+ = No. of Antibody positive

TABLE 6
Hantavirus antigen and antibody positive small mammals in IVANJICA region according to age and sex

| IVANJICA | No.trapped | Ag+ | Ab+ | Ag+ and Ab+ | Juvenile form | Subadult form | Adult form | Male | Female |
|---|---|---|---|---|---|---|---|---|---|
| APODEMUS FLAVICOLLIS | 12 | 3 | 2 | 1 | 0 | 0 | 12 | 4 | 8 |
| A.SYLVATICUS | 17 | 4 | 0 | 0 | 0 | 1 | 16 | 6 | 11 |
| CL.GLAREOLUS | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 1 |
| PITIMYS SUBTERRANEUS | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| MUS MUSCULUS | 7 | 3 | 0 | 0 | 0 | 0 | 7 | 3 | 4 |
| SOREX ARANEUS | 2 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 2 |
| NEOMIS FODIENS | 2 | 2 | 0 | 0 | 0 | 0 | 2 | 1 | 1 |
| TOTAL No. | 42 | 15 | 3 | 2 | 0 | 2 | 40 | 14 | 28 |

Ag+ = No. of Antigen positive
Ab+ = No. of Antibody positive

TABLE 7
Hantavirus antigen and antibody positive small mammals in POZAREVAC region according to age and sex

| POZAREVAC | No.trapped | Ag + | Ab+ | Ag+ and Ab+ | Juvenile form | Subadult form | Adult form | Male | Female |
|---|---|---|---|---|---|---|---|---|---|
| APODEMUS AGRARIUS | 20 | 4 | 2 | 2 | 2 | 8 | 10 | 9 | 11 |
| A.FLAVICOLLIS | 11 | 1 | 1 | 1 | 0 | 1 | 10 | 6 | 5 |
| A.MICROPS | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| A.SYLVATICUS | 24 | 5 | 2 | 1 | 0 | 2 | 22 | 9 | 15 |
| MICROTUS ARVALIS | 2 | 0 | 0 | 0 | 0 | 1 | 1 | 2 | 0 |
| PITIMYS SUBTERRANEUS | 2 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 2 |
| MUS MUSCULUS | 21 | 8 | 4 | 4 | 4 | 7 | 10 | 11 | 10 |
| RATTUS NORVEGICUS | 5 | 5 | 4 | 4 | 0 | 0 | 5 | 2 | 3 |
| CROCIDURA SUB. | 5 | 1 | 0 | 0 | 0 | 0 | 5 | 3 | 2 |
| TOTAL No. | 91 | 24 | 13 | 12 | 6 | 20 | 65 | 42 | 49 |

Ag+ = No. of Antigen positive
Ab+ = No. of Antibody positive

TABLE 8
Hantavirus antigen and antibody positive small mammals in
KARLOVAC region according to age and sex

| KARLOVAC | No.trapped | Ag+ | Ab+ | Ag+andAb+ | Juvenile form | Subadult form | Adult form | Male | Female |
|---|---|---|---|---|---|---|---|---|---|
| APODEMUS FLAVICOLLIS | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 |
| A.SYLVATICUS | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 |
| RATTUS NORVEGICUS | 16 | 4 | 7 | 2 | 6 | 0 | 10 | 6 | 10 |
| TOTAL No. | 18 | 6 | 7 | 2 | 6 | 0 | 12 | 8 | 10 |

Ag+ = No.of Antigen positive
Ab+ = No .of Antibody positive

TABLE 9
Hantavirus antigen and antibody positive small mammals in
NOVO MESTO region according to age and sex

| NOVO MESTO | No.trapped | Ag+ | Ab+ | Ag+ and Ab+ | Juvenile form | Subadult form | Adult form | Male | Female |
|---|---|---|---|---|---|---|---|---|---|
| APODEMUS SYLVATICUS | 6 | 1 | 0 | 0 | 1 | 1 | 4 | 4 | 2 |
| PITIMYS SUBTERRANEUS | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| RATTUS NORVEGICUS | 3 | 2 | 0 | 0 | 0 | 0 | 3 | 2 | 1 |
| TOTAL No. | 10 | 3 | 0 | 0 | 1 | 1 | 8 | 6 | 4 |

Ag+ = No. of Antigen positive
Ab+ = No. of Antibody positive

TABLE 10
Hantavirus antigen and antibody positive small mammals in PLITVICE region according to age and sex

| PLITVICE | No.trapped | Ag+ | Ab+ | Ag+andAb+ | Juvenile form | Subadult form | Adult form | Male | Female |
|---|---|---|---|---|---|---|---|---|---|
| APODEMUS FLAVICOLLIS | 84 | 17 | 27 | 9 | 2 | 17 | 65 | 47 | 37 |
| CI.GLAREOLUS | 60 | 18 | 30 | 14 | 0 | 3 | 57 | 18 | 42 |
| SOREX ALPINUS | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| TOTAL No. | 145 | 36 | 57 | 23 | 2 | 20 | 123 | 65 | 80 |

Ag+ = No. of Antigen positive
Ab+ = No. of Antibody positive

TABLE 11
Hantavirus antigen and antibody positive small mammals in OLOVO region according to age and sex

| OLOVO | No.trapped | Ag+ | Ab+ | Ag+ and Ab+ | Juvenile form | Subadult form | Adult form | Male | Female |
|---|---|---|---|---|---|---|---|---|---|
| APODEMUS FLAVICOLLIS | 28 | 7 | 12 | 5 | 0 | 2 | 26 | 22 | 6 |
| A.SYLVATICUS | 6 | 1 | 3 | 1 | 0 | 0 | 6 | 2 | 4 |
| MUS MUSCULUS | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 |
| TOTAL No. | 35 | 9 | 16 | 7 | 0 | 2 | 33 | 25 | 10 |

Ag+ = No. of Antigen positive
Ab+ = No. of Antibody positive

TABLE 12

Hantavirus antigen and antibody positive small mammals in HADICI rergion according to age and sex

| HADICI | No.trapped | Ag+ | Ab+ | Ag+ and Ab+ | Juverile form | Subadult form | Adult form | Male | Female |
|---|---|---|---|---|---|---|---|---|---|
| APODEMUS FLAVICOLLIS | 49 | 22 | 24 | 15 | 1 | 0 | 48 | 35 | 14 |
| A.SYLVATICUS | 2 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 2 |
| CI.GLAREOLUS | 2 | 1 | 0 | 0 | 0 | 0 | 2 | 0 | 2 |
| MICROTUS SPECIES | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 |
| TOTAL No. | 54 | 23 | 24 | 15 | 1 | 1 | 52 | 36 | 18 |

Ag+ = No. of Antigen positive
Ab+ = No. of Antibody positive

TABLE 13
Percentage of hantavirus antigen and antibody positive
APODEMUS FLAVICOLLIS by age and sex in different foci of HFRS in 1989

| APODEMUS FLAVICOLLIS | CACAK | IVANJICA | POZAREVAC | KARLOVAC | NOVOMESTO | PLITVICE | OLOVO | HADICI | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| No. trapped | 1 | 12 | 11 | 1 | 3 | 84 | 28 | 49 | 189 |
| % | 0.7 | 28.6 | 12.2 | 5.5 | 30.0 | 57.9 | 80.0 | 90.7 | 33.8 |
| %Ag+ | 100.0 | 25.0 | 9.1 | 100.0 | 66.7 | 20.2 | 25.0 | 44.4 | 28.6 |
| %Ab+ | 0.0 | 16.7 | 9.1 | 0.0 | 0.0 | 32.5 | 48.0 | 48.9 | 35.9 |
| %Ag+ and Ab+ | 0.0 | 8.3 | 9.1 | 0.0 | 0.0 | 10.7 | 17.8 | 30.6 | 17.9 |
| % Juvenile | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.4 | 0.0 | 2.1 | 1.6 |
| % Subadult | 0.0 | 0.0 | 9.1 | 0.0 | 0.0 | 20.2 | 7.1 | 0.0 | 10.5 |
| % Adult | 100.0 | 100.0 | 90.9 | 100.0 | 100.0 | 77.4 | 92.9 | 97.9 | 87.9 |
| Male | 100.0 | 35.0 | 54.5 | 100.0 | 66.6 | 55.9 | 78.6 | 71.4 | 58.9 |
| Female | 0.0 | 65.0 | 45.5 | 0.0 | 33.3 | 44.1 | 21.4 | 28.6 | 41.1 |

Ag+ = Antigen positive
Ab+ = Antibody positive

TABLE 14
Percentage of hantavirus antigen and antibody positive
APODEMUS SYLVATICUS by age and sex in different foci of HFRS in 1989

| APODEMUS SYLVATICUS | CACAK | IVANJICA | POZAREVAC | KARLOVAC | NOVO MESTO | PLITVICE | OLOVO | HADICI | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| No.trapped | 90 | 17 | 24 | 1 | 6 | 0 | 6 | 2 | 146 |
| % | 60.4 | 40.5 | 26.7 | 6.3 | 60.0 | 0.0 | 17.1 | 3.7 | 26.9 |
| %Ag+ | 15.5 | 23.5 | 20.8 | 100.0 | 16.7 | 0.0 | 16.7 | 0.0 | 17.8 |
| %Ab+ | 4.4 | 0.0 | 8.3 | 0.0 | 0.0 | 0.0 | 50.0 | 0.0 | 6.2 |
| %Ag+ and Ab+ | 4.4 | 0.0 | 4.2 | 0.0 | 0.0 | 0.0 | 16.7 | 0.0 | 4.1 |
| % Juvenile | 2.2 | 0.0 | 0.0 | 0.0 | 16.7 | 0.0 | 0.0 | 0.0 | 2.1 |
| % Subadult | 28.8 | 5.9 | 8.3 | 0.0 | 16.7 | 0.0 | 0.0 | 50.0 | 21.2 |
| % Adult | 69.0 | 94.1 | 91.7 | 100.0 | 66.6 | 0.0 | 100.0 | 50.0 | 76.7 |
| Male | 34.4 | 35.3 | 37.5 | 100.0 | 66.6 | 0.0 | 33.4 | 0.0 | 60.9 |
| Female | 25.6 | 64.7 | 62.5 | 0.0 | 33.4 | 0.0 | 66.6 | 100.0 | 39.1 |

Ag+ = Antigen positive
Ab+ = Antibody positive

TABLE 15
Percentage of hantavirus antigen and antibody positive
APODEMUS AGRARIUS by age and sex in different foci of HFRS in 1989

| APODEMUS AGRARIUS | CACAK | IVANJICA | POZAREVAC | KARLOVAC | NOVO MESTO | PLITVICE | OLOVO | HADICI | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| No.trapped | 44 | 0 | 20 | 0 | 0 | 0 | 0 | 0 | 64 |
| % | 29.5 | 0.0 | 22.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 11.8 |
| % Ag+ | 15.9 | 0.0 | 20.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 17.2 |
| % Ab+ | 4.5 | 0.0 | 10.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 9.4 |
| % Ag+ and Ab+ | 4.5 | 0.0 | 10.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 9.4 |
| % Juvenile | 2.3 | 0.0 | 10.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4.7 |
| % Subadult | 61.4 | 0.0 | 40.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 56.2 |
| % Adult | 36.3 | 0.0 | 50.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 39.1 |
| Male | 50.0 | 0.0 | 45.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 48.4 |
| Female | 50.0 | 0.0 | 55.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 51.6 |

Ag+ = Antigen positive
Ab+ = Antibody positive

TABLE 16
Percentage of hantavirus antigen and antibody positive
CLETHRIONOMYS GLAREOLUS by age and sex in different foci of HFRS in 1989

| CLETHRIONOMYS GLAREOLUS | CACAK | IVANJICA | POZAREVAC | KARLOVAC | NOVO MESTO | PLITVICE | OLOVO | HADICI | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| No.trapped | 0 | 1 | 0 | 0 | 0 | 60 | 0 | 2 | 63 |
| % | 0.0 | 2.4 | 0.0 | 0.0 | 0.0 | 41.2 | 0.0 | 4.1 | 11.6 |
| % Ag+ | 0.0 | 100.0 | 0.0 | 0.0 | 0.0 | 30.0 | 0.0 | 50.0 | 31.7 |
| % Ab+ | 0.0 | 100.0 | 0.0 | 0.0 | 0.0 | 51.7 | 0.0 | 0.0 | 50.8 |
| % Ag+ and Ab+ | 0.0 | 100.0 | 0.0 | 0.0 | 0.0 | 24.1 | 0.0 | 0.0 | 24.6 |
| % Juvenile | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| % Subadult | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5.0 | 0.0 | 50.0 | 4.8 |
| % Adult | 0.0 | 100.0 | 0.0 | 0.0 | 0.0 | 95.0 | 0.0 | 50.0 | 95.2 |
| Male | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 30.0 | 0.0 | 0.0 | 28.6 |
| Female | 0.0 | 100.0 | 0.0 | 0.0 | 0.0 | 70.0 | 0.0 | 100.0 | 71.4 |

Ag+ = Antigen positive
Ab+ = Antibody positive

TABLE 17
Percentage hantavirus antigen and antibody positive
MUS MUSCULUS by age and sex in different foci of HFRS in 1989

| MUS MUSCULUS | CACAK | IVANJICA | POZAREVAC | KARLOVAC | NOVO MESTO | PLITVICE | OLOVO | HADICI | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| No.trapped | 0 | 0 | 21 | 0 | 0 | 0 | 1 | 0 | 22 |
| % | 0 | 0 | 23.3 | 0 | 0 | 0 | 2.8 | 0 | 4.1 |
| % Ag+ | 0 | 0 | 40.0 | 0 | 0 | 0 | 100.0 | 0 | 32.1 |
| %Ab+ | 0 | 0 | 22.2 | 0 | 0 | 0 | 100.0 | 0 | 19.2 |
| % Ag+ and Ab+ | 0 | 0 | 22.2 | 0 | 0 | 0 | 100.0 | 0 | 19.2 |
| % Juvenile | 0 | 0 | 19.1 | 0 | 0 | 0 | 0.0 | 0 | 18.2 |
| % Subadult | 0 | 0 | 33.3 | 0 | 0 | 0 | 0.0 | 0 | 31.8 |
| % Adult | 0 | 0 | 47.6 | 0 | 0 | 0 | 100.0 | 0 | 50.0 |
| Male | 0 | 0 | 52.4 | 0 | 0 | 0 | 100.0 | 0 | 50.0 |
| Female | 0 | 0 | 47.6 | 0 | 0 | 0 | 0.0 | 0 | 50.0 |

Ag+ = Antigen positive
Ab+ = Antibody positive

TABLE 18
Percentage hantavirus antigen and antibody positive
RATTUS NORVEGICUS by age and sex in different foci of HFRS in 1989

| RATTUS NORVEGICUS | CACAK | IVANJICA | POZAREVAC | KARLOVAC | NOVO MESTO | PLITVICE | OLOVO | HADICI | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| No trapped | 0 | 0 | 5 | 16 | 0 | 0 | 0 | 0 | 21 |
| % | 0 | 0 | 5.5 | 88.9 | 0 | 0 | 0 | 0 | 3.9 |
| %Ag+ | 0 | 0 | 100.0 | 25.0 | 0 | 0 | 0 | 0 | 42.8 |
| %Ab+ | 0 | 0 | 80.0 | 43.7 | 0 | 0 | 0 | 0 | 52.4 |
| % Ag+ and Ab+ | 0 | 0 | 80.0 | 12.5 | 0 | 0 | 0 | 0 | 28.6 |
| % Juvenile | 0 | 0 | 0.0 | 37.5 | 0 | 0 | 0 | 0 | 28.6 |
| % Subadult | 0 | 0 | 0.0 | 0.0 | 0 | 0 | 0 | 0 | 0.0 |
| % Adult | 0 | 0 | 100.0 | 62.5 | 0 | 0 | 0 | 0 | 71.4 |
| Male | 0 | 0 | 40.0 | 37.5 | 0 | 0 | 0 | 0 | 38.1 |
| Female | 0 | 0 | 60.0 | 62.5 | 0 | 0 | 0 | 0 | 61.9 |

Ag+ = Antigen positive
Ab+ = Antibody positive

TABLE 19
Percentage hantavirus antigen and antibody positive
CROCIDURA SPECIES by age and sex in different foci OF HFRS in 1989

| CROCIDURA SPECIES | CACAK | IVANJICA | POZAREVAC | KARLOVAC | NOVO MESTO | PLITVICE | OLOVO | HADICI | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| No trapped | 8 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 13 |
| % | 5.4 | 0 | 5.5 | 0 | 0 | 0 | 0 | 0 | 2.4 |
| % Ag+ | 25.0 | 0 | 20.0 | 0 | 0 | 0 | 0 | 0 | 23.1 |
| %Ab+ | 0.0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| % Ag+ and Ab+ | 0.0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| % Juvenile | 0.0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 0.0 |
| % Subadult | 75.0 | 0 | 0.0 | 0 | 0 | 0 | 0 | 0 | 15.4 |
| % Adult | 25.0 | 0 | 100.0 | 0 | 0 | 0 | 0 | 0 | 84.6 |
| Male | 50.0 | 0 | 60.0 | 0 | 0 | 0 | 0 | 0 | 53.8 |
| Female | 50.0 | 0 | 40.0 | 0 | 0 | 0 | 0 | 0 | 46.2 |

Ag+ = Antigen positive
Ab+ = Antibody positive

Table 20.

ANTIBODIES TO HANTAAN AND PUUMALA VIRUSES IN HEALTHY RESIDENTS OF YUGOSLAVIA IN 1989.

| Location | No.sera positive No.sera tested | % positive | No. of HFRS cases |
|---|---|---|---|
| Ivanjica | 45/84 | 54 | > 12 |
| Požarevac | 6/12 | 50 | 4 |
| Foča | 22/73 | 20.5 | > 10 |
| T o t a l | 73/169 | 42,0 | > 26 |

Table 21.

ANTIBODIES TO HANTAAN AND PUUMALA VIRUSES IN HEALTHY RESIDENTS OF OLOVO AND HADŽIĆI IN 1989.

| Location | No.sera tested | No.sera positive | | | % positive | No.of HFRS cases |
|---|---|---|---|---|---|---|
| | | HNT | Puumala | HNT + Puumala | | |
| Olovo | 78 | 8 | 3 | 5 | 20.5 | > 30 |
| Hadžići | 75 | 14 | 3 | 1 | 24.0 | > 40 |
| T o t a l | 153 | 22 | 6 | 6 | 22.2 | > 80 |

Table 22.

ANTIBODIES TO HANTAAN AND PUUMALA VIRUSES IN HEALTHY PERSONS FROM YUGOSLAVIA IN 1989.

| Occupation of persons | No.sera tested | No. of positive | | | % positive | No.of HFRS cases |
|---|---|---|---|---|---|---|
| | | HNT | Puumala | HNT + Puumala | | |
| Residents of Oštarije place | 193 | 10 | - | - | 5.2 | 3 |
| Forest workers near Oštarije | 45 | - | - | 1 | 2.2 | - |
| Soldiers from all around Yugoslavia | 201 | 5 | 6 | 1 | 5.9 | 223 |
| T o t a l | 439 | 15 | 6 | 2 | 5.2 | 226 |

T A B L E 23.

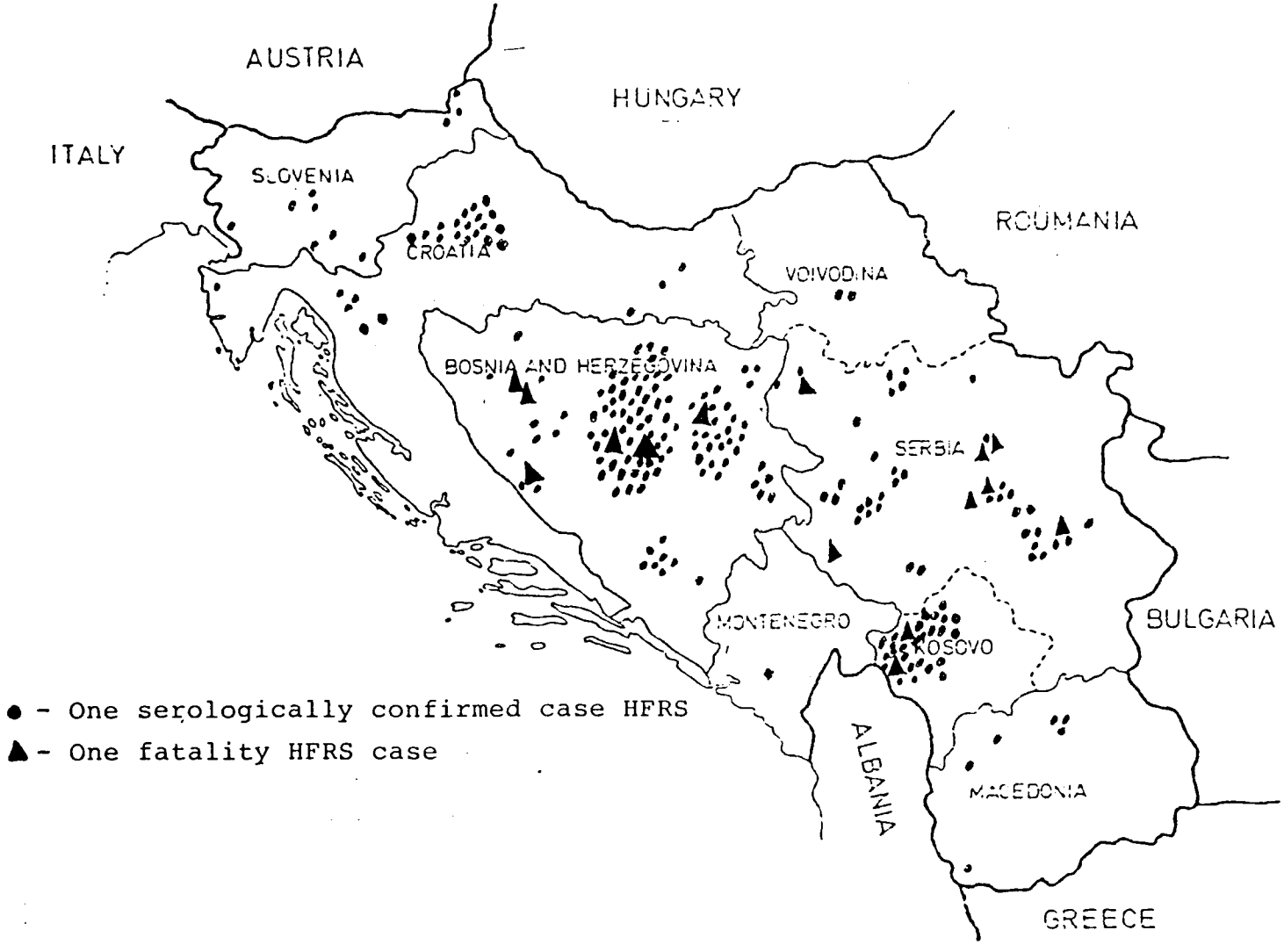
HFRS IN YUGOSLAVIA IN 1989 *

| Republics and Provinces | No. clinically suspected HFRS | No. serologically positive | % positive | Lethality | % |
|---|---|---|---|---|---|
| SR BOSNIA AND HERZEGOVINA | 226 | 108 | 40,6 | 6 | 5,5 |
| SR CROATIA | 47 | 27 | 57,5 | - | - |
| SR MACEDONIA | 15 | 6 | 40,0 | - | - |
| SR MONTENEGRO | 4 | 1 | 25,0 | - | - |
| SR SLOVENIA | _ | 10 | - | - | - |
| SR SERBIA | 179 | 43 | 24,0 | 7 | 16,3 |
| a) KOSOVO | 83 | 29 | 28,6 | 2 | 6,9 |
| b) VOJVODINA | 15 | 2 | 13,3 | - | - |
| TOTAL | 609 | 226 | 37,1 | 15 | 6,6 |

*These data were formed on the base of serologically examined sera in National Reference Laboratory for viral hemorrhagic fever in Belgrade, using immunofluorescent test and ELISA IgM test with Hantaan and Puumala antigens.

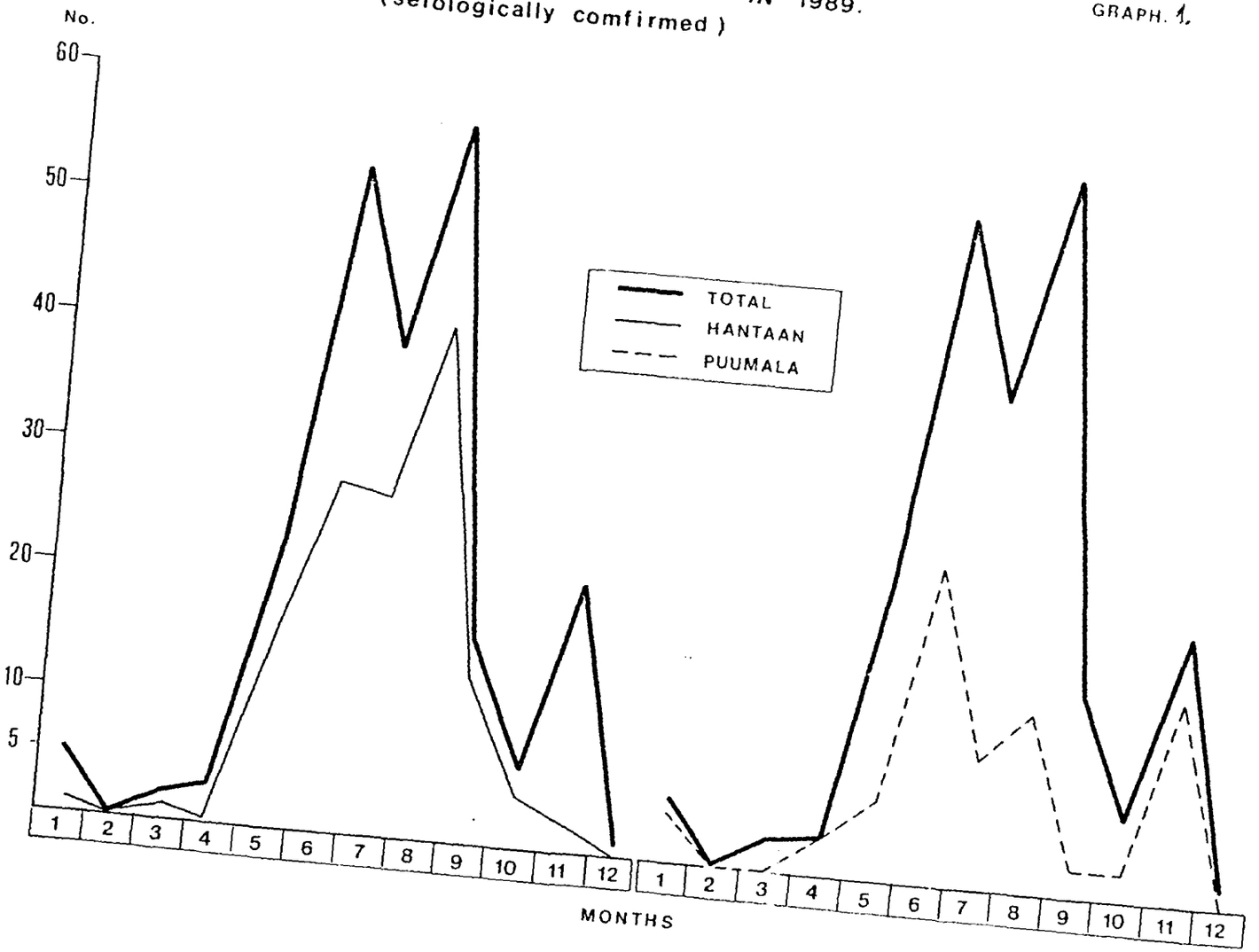
DISTRIBUTION OF SEROLOGICALLY CONFIRMED CASES OF HFRS
in Yugoslavia in 1989

Map 1.

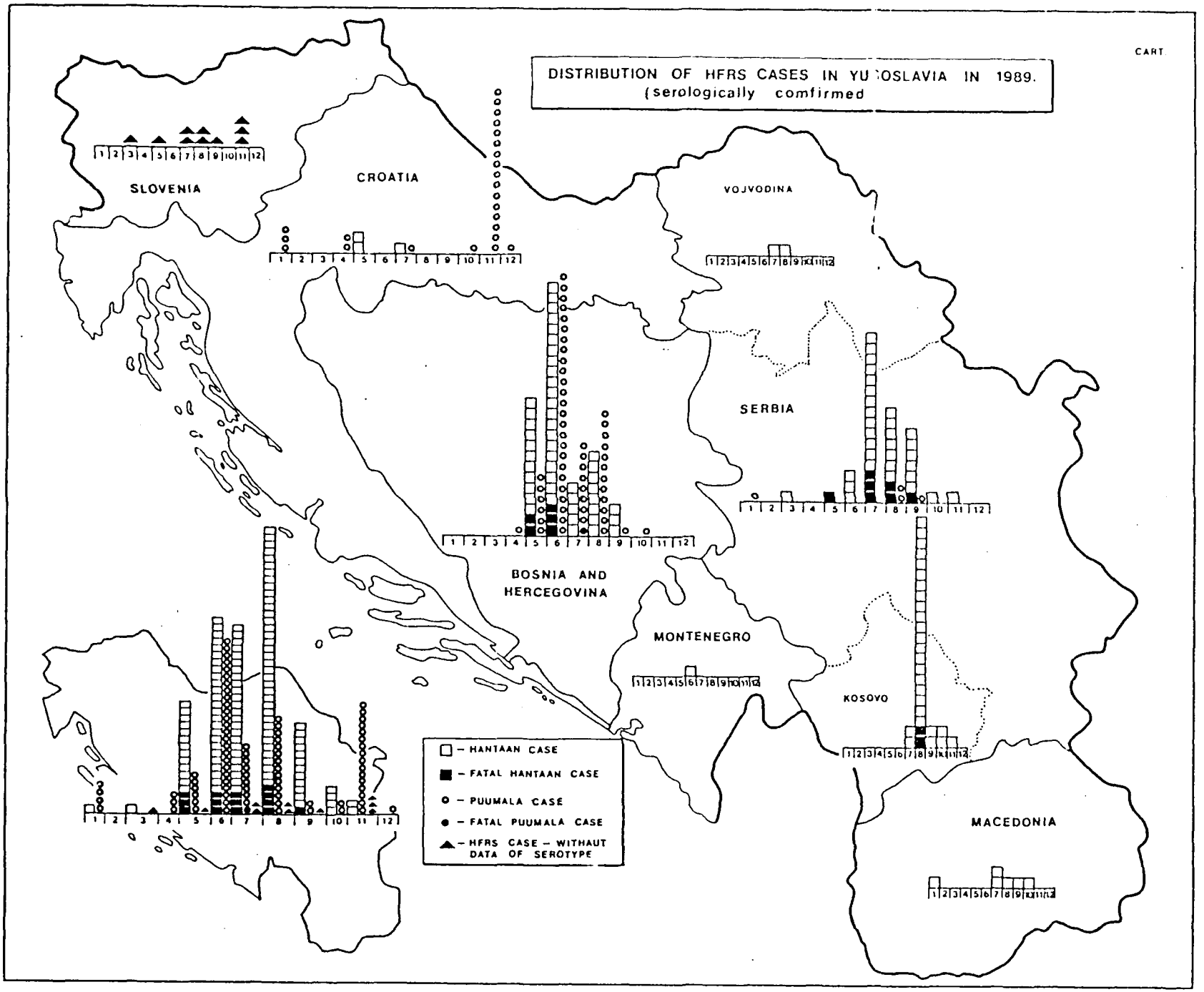


HFRS CASES IN YUGOSLAVIA IN 1989.
(serologically comfirmed)

GRAPH. 1.



Graph 2


DISTRIBUTION OF HFRS CASES IN YUGOSLAVIA IN 1989.
(serologically comfirmed
CART
SLOVENIA
CROATIA
VOJVODINA
SERBIA
BOSNIA AND HERCEGOVINA
MONTENEGRO
KOSOVO
MACEDONIA
– HANTAAN CASE
– FATAL HANTAAN CASE
– PUUMALA CASE
– FATAL PUUMALA CASE
– HFRS CASE – WITHAUT DATA OF SEROTYPE